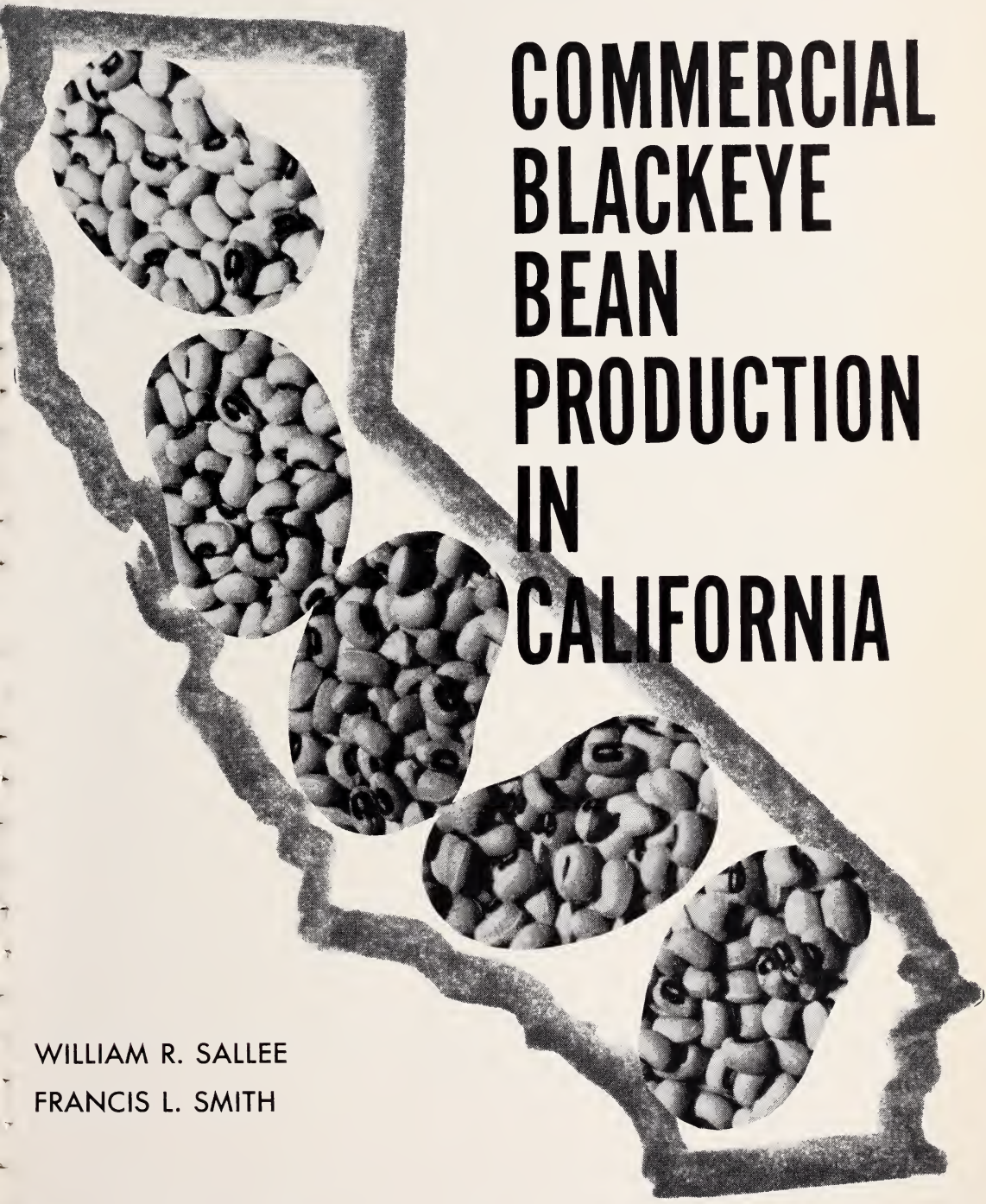
Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA



COMMERCIAL BLACKEYE BEAN PRODUCTION IN CALIFORNIA

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CALIFORNIA AGRICULTURAL
Experiment Station
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CIRCULAR 549

Blackeye beans are one of the two leading classes of dried, edible beans in California. As a rotation crop, they leave a residue of nitrogen in the soil that is beneficial to succeeding crops. This circular discusses varieties and seed, land preparation, crop maintenance, pests and diseases, and harvesting and marketing.

For specific information on spray control for pests and diseases and weed control and use of herbicides, consult your local Farm Advisor or see:

- **Pest and Disease Control Program for Beans and Peas**
- **Weed Control Recommendations (Leaflet 168 Revised)**

These U.C. Agricultural Experiment Station and Extension publications are available at your Farm Advisor's office.

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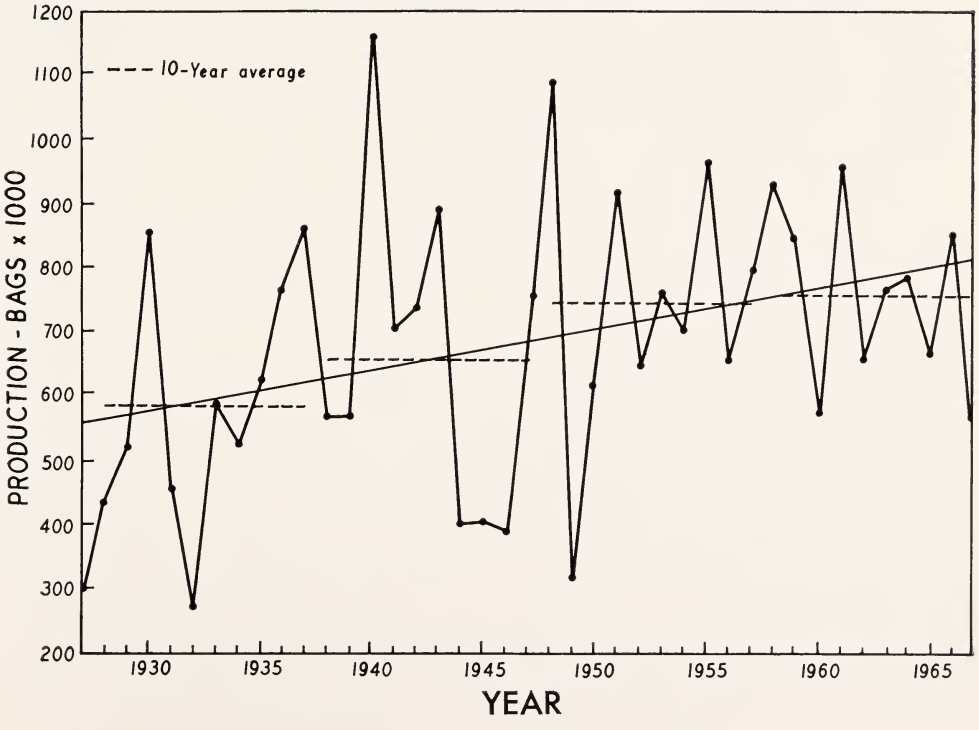
History and Background

Blackeyes may be called either peas or beans. They are "blackeye peas" in the southern United States. In California they are called blackeye beans or simply blackeyes, because the methods of harvest and storage are the same as for dried-bean varieties, such as pinks or pintos.

The blackeye bean (*Vigna sinensis*), a variety of cowpea, is one of man's most ancient crops. Native to central Africa, it spread to Asia and the Mediterranean regions of Europe where it was described by early Roman writers. A number of varieties were brought to the United States during colonial times. Here, blackeyes found a natural home in the South where they are still popular.

Southerners cultivate several varieties of cowpea, including blackeye, for green beans, cover crops, hay, and dried beans. The ripe seed for human consumption is grown primarily in California and Texas. Now, it is shipped not only to the South, but to all areas of the United States and several foreign countries. Blackeye beans were included in California market reports as early as 1880.

Fig. 1. Annual production of blackeye beans in California (1928 to 1967). Note dramatic fluctuations. Regression line indicates that production has increased at the rate of 5,750 bags per year.



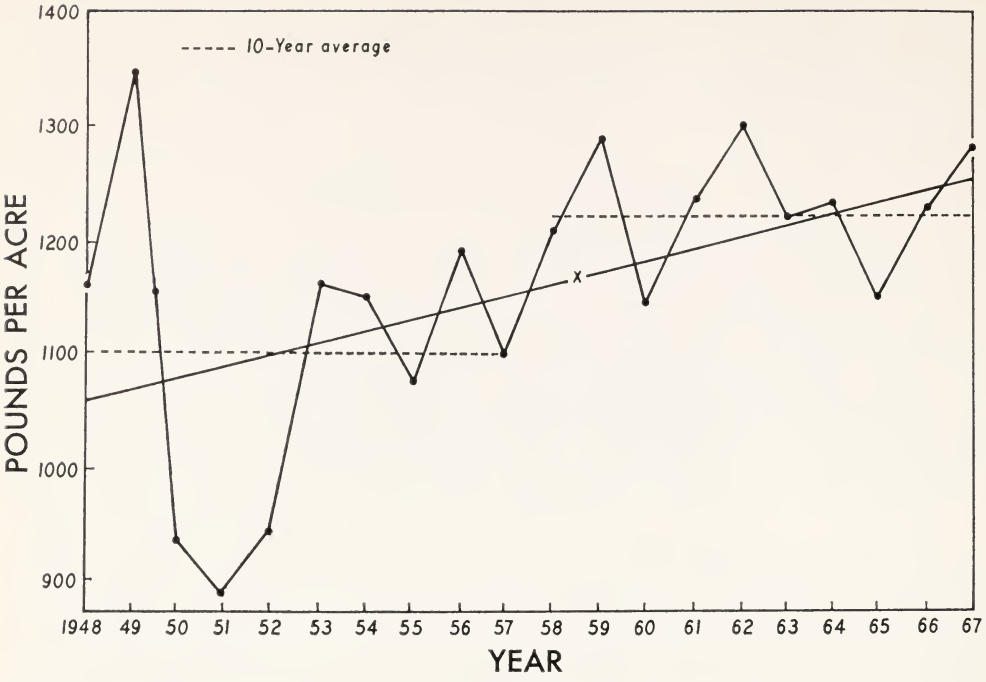
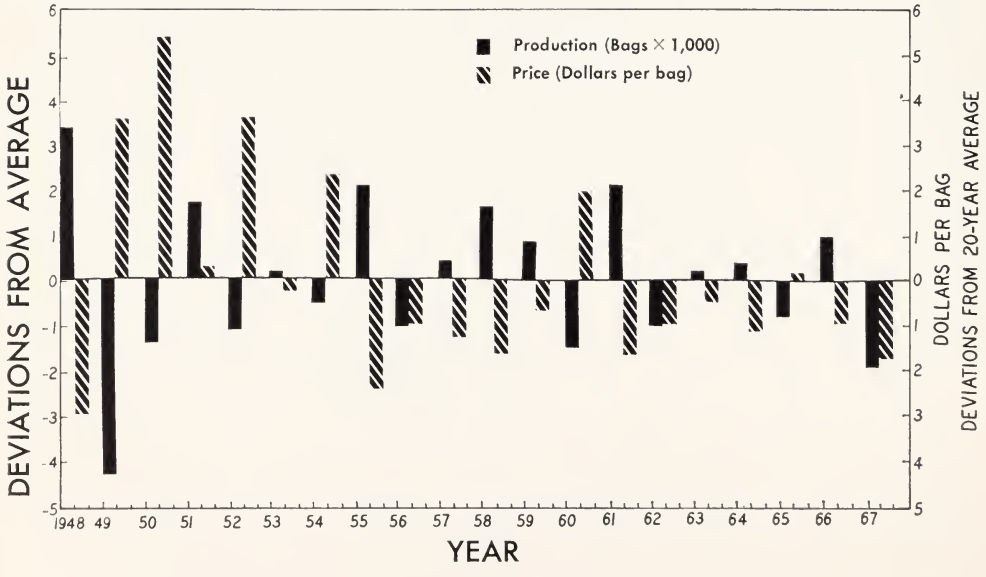


Fig. 2 (above). Annual yields in pounds per acre of California blackeye beans (1948 to 1967).

Fig. 3 (below). Annual deviations from 20-year average of production and price per bag of blackeye beans in California (1948 to 1967). Note that low production is generally followed by high prices. Then, high prices are followed by high production. Exceptions occurred in 1951 when both production and price were above average, and in 1956, 1962, and 1967 when production and price were below average.



Blackeyes are grown in the central valleys, southern California, and the southern coastal counties. Most of the acreage is in the San Joaquin Valley. During the past 10 years, the large acreage of blackeyes in the northern San Joaquin Valley has shifted to the central and southern portion of the Valley, primarily due to fusarium wilt (usually called cowpea wilt).

Production trends (figs. 1 to 3)

Nine market classes of dry, edible beans are produced in California, with only a small proportion of the crop processed for the fresh and frozen markets to be consumed as green beans. In the past 10 years, the two leading market classes have been Large Limas, with an average of 24 per cent, and blackeyes, 23 per cent, of the total bean production. The average annual production of blackeyes was 752,300 bags on 65,250 acres during the period from 1948 to 1967.

Although acreage and production are generally correlated on a year-to-year basis, overall trends indicate that acreage is decreasing, while the average yields per acre are increasing.

The number of acres of blackeyes planted varies from year to year. High prices are generally followed by high production the next season, and low prices are followed by low production. According to data from market reports, bean prices for the preceding year account for over 40 per cent of the annual variation in the number of acres planted. That acreage is determined individually by hundreds of growers according to the past season's prices. Until a better system of marketing is established, wide fluctuations in acreage and price will continue.

Climate

Blackeye beans are primarily adapted to the climate of the central valleys. Although California-grown blackeyes are more heat-tolerant than other dry beans, the excessively high temperatures of the Imperial and Coachella valleys tend to reduce yields. Blackeyes are not usually grown in areas of high rainfall. Rainfall may damage young seedlings and later delay harvest or reduce the quality of the crop.

Most of the acreage of blackeyes is under irrigation. A small acreage is dryland farmed, utilizing moisture from winter rains, but yields are considerably less than with irrigated beans.

Use in crop rotation

After harvest, blackeye straw is beneficial when incorporated into the soil. Abundantly nodulated when the seed is properly inoculated and planted in adaptable soils, the roots are rich in nitrate nitrogen. The residual nitrogen left in the soil when blackeyes are grown is beneficial to succeeding crops.

Varieties and Seed

The most common variety grown in California is California Blackeye 5. Since this early-maturing variety has only a slight tolerance to fusarium wilt, it should be grown in a short rotation (one to two years) with nonsusceptible crops to prevent this disease from building up in the soil.

Blackeye 3 is the major variety in the northern San Joaquin Valley where fusarium wilt is serious. It is more tolerant to this disease than Blackeye 5. However, when either of these varieties is grown in the presence of the nematode, *Meloidogyne javanica*, it becomes susceptible to fusarium wilt. Areas damaged by both this nematode and fusarium wilt must be fumigated.

Blackeye 3 matures later than Blackeye 5, and its prostrate growth habit makes irrigation difficult as it matures.

Certified seed

Standards and regulations for growing certified seed are developed and maintained through the California Crop Improvement Association. Applications to grow certified blackeyes must be made each year before July 15 at the Farm Advisor's office. The Farm Advisor also may be consulted for detailed information on growing certified seed.

Planting the Crop

Soils

Blackeyes are best adapted to light, sandy loam soils. They grow satisfactorily on well-drained, heavier, clay loams, but yields are usually less than on lighter soils. Saline and alkali soils should be avoided; yields on such soils are usually poor and unprofitable.

A good stand of blackeyes on heavy clay soils requires careful attention to seedbed preparation. In heavy soils, the hazards to germination are fewer and crusting is less severe with raised beds than with a flat surface. Irrigation management on heavy clay soils also requires careful attention, since blackeyes become iron-deficient if too much water is applied. Iron deficiency causes yellowing of the leaves—usually a temporary condition which disappears as soon as the field is aerated by cultivation.

Preparing the land

Land preparation for blackeyes is similar to that for most other field crops. Overworking the soil to get a fine, pulverized seedbed is not necessary. Soil compaction, however, does call for subsoiling; but if the compaction is near the soil surface, chiseling or plowing accomplishes the same purpose.

Residue from the preceding crop should be incorporated into the soil early enough to decompose.

Pre-irrigation with 6 to 8 inches of water may be necessary, unless rainfall has wet the soil to a depth of 3 to 4 feet. After pre-irrigation, soil should be tilled to break the soil crust and large clods. Extensive cultivation is not only expensive, but is causes compaction, root pruning, and loss of moisture.

Blackeyes can be planted on the flat soil surface or on prepared beds. Heavy soils warm faster when beds are formed, favoring better germination. Beds should be knocked down to about ground level to prevent deep furrows at harvest time. Deep furrows are to be avoided, since raking out the cut beans pulls soil into the bean windrow and makes cleaning difficult.

Planting time

In most areas, blackeyes are planted from May 1 to June 15. Later planting runs the risk of fall rain damage at harvest time. Soil temperatures of 70° F or above are optimum for good germination. Soil moisture for planting should be at a level that provides good tillage.

Row spacing and planting methods

Row spacing for blackeyes ranges from 30 to 40 inches. In experiments at the University of California at Davis, yields were highest when blackeyes were planted on 30- to 32-inch rows. In the southern San Joaquin Valley, blackeyes are usually planted with the same row spacing—38 to 40 inches—as is used for the principal crop, cotton.

The grower should change to bean plates when a cotton planter is used. The

indent-cup planter places the beans evenly and does not crack the seed. Stands are usually better when the soil around the seed is firmed with a roller-press wheel or drag chain.

For maximum germination, seeds should be placed at least 1 inch deep in moist soil. If blackeyes are planted late, the surface dries faster, making it necessary to place the seed slightly deeper—about 1½ inches into moist soil.

Rate of seeding

With lighter soils, a planting rate of 20 pounds per acre is sufficient. On heavier-textured soils, 25 pounds per acre is suggested. When conditions are unfavorable, as with a cloddy seedbed or cold soil, 30 to 35 pounds per acre may be needed. Three plants per foot are an ideal plant population, but University of California field trials have shown that plant spacing ranging from 4 to 12 inches did not reduce production.

Seed treatment

Practically all seed is treated commercially with a combination fungicide and insecticide at the warehouse before it is sold for planting. If untreated seed is planted, seedling diseases can seriously reduce germination and seedling vigor.

The combination treatment provides some protection to the seed and plant against wireworms and seed corn maggot. Wireworms feed underground on seeds and roots of both young and mature plants. The seed corn maggots feed on germinating seeds, roots, and, sometimes, stems. When a field has a history of damage from either of these pests, the soil should be examined several weeks before planting. Soil treatment with a chemical may be necessary in addition to the seed treatment.

Crop Maintenance

Irrigation

Method and timing of irrigation are critical. Blackeyes are sensitive both to moisture stress and to several hours of saturated soil. Each of these conditions retards the growth of roots and inhibits the activity of nitrogen-fixing bacteria. Excessive water reduces oxygen in the soil which can favor the development of fungus diseases. Too much water also causes blackeye foliage to turn yellow, indicating iron deficiency.

Blackeyes require frequent, shallow irrigations. Most of the moisture used by the blackeye plant comes from the surface foot of soil. For this reason, furrows longer than ¼ mile should be avoided. Short rows provide an even distribution of water over the entire field.

From emergence to pod set, an adequate and even level of moisture is required for a large, healthy plant. A color change, from a bright green to a dark, bluish-green, indicates the need for irrigation.

Irrigation should stop when two-thirds of the pods are yellow, and the lower portion of the plant is defoliating. Irrigating after this stage of maturity usually produces small, pinched beans and delays early harvest, which may allow severe insect problems to develop.

Cultivation and weed control

Soil should be tilled after the crop is planted (1) to furrow-out for irrigation and (2) to control weeds. Most soils planted to blackeyes are first treated with herbicides to control weeds, thus reducing tillage needs to a minimum. Heavier soils may crust after a rain or irrigation; this calls for a shallow cultivation to break the crust and aerate the soil. Depth of cultivation should be as shallow as possible to prevent excess moisture loss and root pruning.

Fig. 4. Nightshade is a difficult weed to control in blackeyes. In the processing plant, also, the seed sticks to the rough seed coat of the blackeye.

Harvesting is difficult when weeds are not controlled. Weed seed lowers the quality of threshed beans and, in the case of certified bean seed, may keep the seed from meeting certification requirements. Excess weed seed in certified beans will also necessitate recleaning, and thus add to the cost of processing.

Selective herbicides control annual grasses and several broadleaved weeds. Some weeds, however, may have to be cultivated or hand-rogued. Heavy infestations of johnsongrass, nutgrass, and nightshade are so difficult to control in blackeyes, that planting this crop may not be advisable. For weed control recommendations and the use of herbicides, consult your Farm Advisor.

Fertilization

Nitrogen, phosphorus, and potassium treatments seldom affect blackeyes, according to University of California field tests, although foliar applications of minor elements, such as iron or zinc, are sometimes necessary.

Inoculation. In the nodules on the roots of blackeyes, nitrogen compounds from the air are synthesized by the bacteria, rhizobia. This bacteria assures the plant's major source of nitrogen. The inoculated seed is not affected by seed treatment for diseases or insects.

Inoculated seed should be used in all fields where blackeyes have not been grown. If seed is not inoculated commercially, the culture may be purchased and mixed with the seed. It is important that fresh cultures of the proper strain for blackeyes be used. The grower may do it himself by following the special instructions on the label of the culture container. Also, the Farm Advisor may be consulted for further information.

For specific instructions on how to determine blackeye fertilization needs, consult your Farm Advisor.

Lygus bugs

Lygus bugs feeding on the flowers and green pods are usually the most damaging pest to blackeye beans. The pest also may reduce the pod set. Pod damage results in unattractive brown spots on the seed; these cannot be removed in the processing plant.

When blackeyes start to bloom and set pods, 10 two-row sweep counts in several areas of the field should be taken for a representative sample of the lygus bug population. When the count reaches one-half lygus per sweep, control should be started immediately.

It is important to check the field frequently and regularly, for lygus populations can increase rapidly. Affected most by lygus are blackeyes adjacent to alfalfa, grain, or safflower. When these crops reach maturity and are harvested, the lygus usually migrates into the bean field—causing populations to increase rapidly. To maintain control of this pest, treatment should be timed according to the alfalfa or grain harvest.

Cowpea weevil

Damage by this pest can be so great that the beans cannot be sold for edible food. The cowpea weevil can infest beans either in the field or when the threshed beans are in storage.

To destroy weevils in the field, blackeye straw should be incorporated into the soil as soon as possible and the field should be irrigated. Bags, storage bins, and beans in storage on the farm should be destroyed or thoroughly fumigated to prevent future weevil damage.

Fig. 5. Lygus bugs suck juice from the green beans in the pod and leave a brown stain on the outside coat of the mature bean. Lygus-damaged beans cannot be cleaned out in the warehouse and are sold at a lower grade.

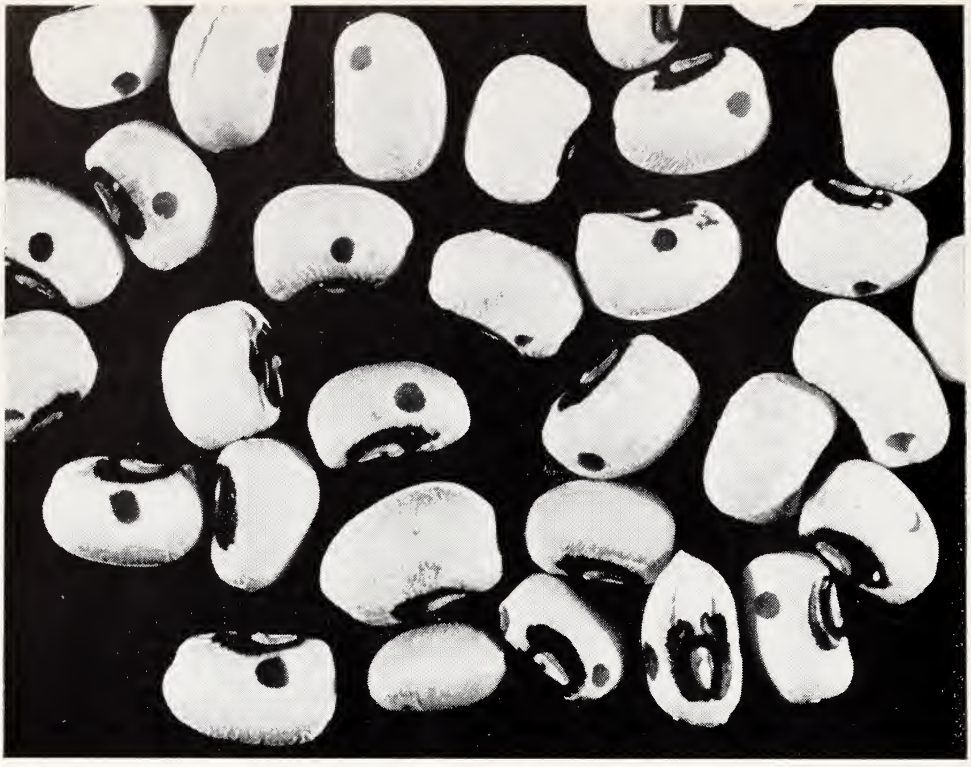


Fig. 6 (above left). Cowpea weevil larvae feed and complete their life cycles inside the blackeyes. When blackeyes have been largely consumed, the adult emerges, leaving a round exit hole as shown in the photo.

Fig. 7 (below left). Corn earworms eat large portions of blackeyes. These pests can be controlled by insecticides.

The safest measure is to ship blackeyes to the warehouse immediately after harvesting the mature crop. Here are the best and most efficient facilities for fumigation.

Other pests

Corn earworms damage the beans by feeding on beans in the pods. Damage is usually greater when blackeyes are grown near corn fields. The beans should be checked as soon as the pods are set. When damage is evident and worms are easily found, control measures should be taken.

Lima bean pod borers only occasionally cause serious damage to blackeyes. This pest cannot be controlled effectively. It is important not to confuse it with the corn earworm, which can be controlled. The pod borer, feeding on young beans, leaves a chaff covered with a clear, gelatinous substance. This chaff distinguishes the lima bean pod borer from the corn earworm. At present, there is no effective control for the pod borer.

Mites are more tolerated by blackeyes than by other beans. In recent years, however, mites have become a serious problem in blackeyes in some areas of California. This could be due to toxic insecticides that kill beneficial insects which might normally control mites.

Cowpea aphids may be abundant in small spots through the field. They seldom build up to populations that require control.

Bean thrips are often found in the early growth stages of blackeyes, but treatment is rarely necessary.

Yellow-striped and beet armyworms may be a problem in years when they are abundant in alfalfa fields and other crops.

For up-to-date information on pest and disease control for blackeye beans and important safety regulations for the use of pesticides, consult your Farm Advisor. As a grower you are legally responsible for residues on your crops, as well as for pesticide drift from your property to other properties or crops.

Root-knot nematode

Meloidogyne javanica feeding on roots causes the plants to wilt, because tissues in the infected roots are unable to translocate sufficient water and nutrients from the soil. The nematode-infested roots show galls and other distortions. Blackeye 5 and Blackeye 3 are resistant to the nematode, *M. incognita*, which attacks cotton.

Nematode infestations are usually less severe in heavy soils.

Fusarium wilt (cowpea wilt)

The fungus *Fusarium oxysporum (f. tracheiphilum)*, is the most common and serious disease of blackeye beans, particularly where the crop is flood-irrigated. In the southern San Joaquin Valley where blackeyes are furrow-irrigated, fusarium wilt is less important. Even so, it is spreading to more fields each year.

The disease spores are harbored in diseased straw or upon the surface, rather than inside the beans. In the early stages of the disease, the small seedling plants wilt. Later, the lower stem and root become swollen with blackened, inner bark extending well up into the plant. Infected plants show yellow leaves in the later stages of maturity. Fusarium wilt should not be confused with verticillium wilt, which is a serious problem in cotton in the San Joaquin Valley. Blackeye 5 is susceptible to fusarium wilt, but is not damaged by verticillium wilt.

Although Blackeye 3 is more tolerant to the disease, and is grown in seriously infested areas, it has some undesirable characteristics, such as a prostrate growth habit, small bean seed, and susceptibility to root-knot nematode in the presence of fusarium wilt. University of California plant breeders are developing fusarium wilt-resistant varieties.

Growers are advised to plant blackeyes for only two years in the same field to prevent a serious buildup of fusarium wilt. Blackeyes then can be rotated with a nonwilt crop, such as corn, sorghum, or grain. Otherwise, resistant varieties are the only means of control.

Other diseases

Cucumber mosaic and southern bean mosaic have become a serious problem in many blackeye fields in the southern San Joaquin Valley. They are more serious on late-planted beans. These virus diseases are transmitted by aphids and by planting seed from an infected field. Infected plants are dwarfed, with mottled, dark-green, distorted leaves.

Curly top, a virus disease carried by the beet leafhopper, is no longer a serious problem in the San Joaquin Valley. The beet leafhopper is presently under control.

The Crop

Harvesting

Harvesting can start when most of the pods have turned yellow, and the beans in the green pods show a definite "eye." Beans in green pods that are not fully developed and do not show the eye portion will shrivel and be blown out the thresher. In the late stage of maturity, the plants will show a few blooms and some new, vegetative growth. These conditions usually will continue until frost. The pods from these few blooms are usually small, and the increase in yield from a delay of harvest does not justify the risk of damage from insects and early fall rain.

Cutting and windrowing should start when the pods are tough enough to keep shatter losses at a minimum. These operations are usually performed early in the morning and stopped when the beans dry to the point of shattering. Beans dry more uniformly and faster when raked into a loose windrow.

Custom-made four-row tractor-mounted bean cutters are commonly used to cut blackeyes. These cutters consist of two V-shaped knives about 5 feet long that cut the beans 2 to 3 inches under the soil surface. After the beans are cut, they are raked into windrows to dry. Self-propelled harvesters pick up the windrowed beans.

Self-propelled swathers are sometimes used to cut the beans above the ground and to windrow in one operation. This method of harvesting has not proved to be as satisfactory as the underground blade system.

Threshing

Blackeyes are easily damaged and usually require large, specially designed harvesters to accommodate the massive vines with minimum cracking of the beans. Self-propelled combines and pull-type harvesters are used mostly on a custom basis. The manufacturer's manual should be thoroughly consulted before adjusting and operating the harvester.

Bulk handling of blackeyes from the thresher to the processing plant has almost replaced bag handling. Flatbed trucks with bulk boxes or dump trucks with grain beds are commonly used to transport beans to the warehouse.

Fig. 8 (above). Cracking results from improper harvesting. Severely cracked blackeyes require a heavy (and costly) clean-out at the processing plant. Cylinder speed on harvesters should be carefully adjusted to prevent this defect.

Fig. 9. Bean cleaner has seven screens with an extra fan for high efficiency.

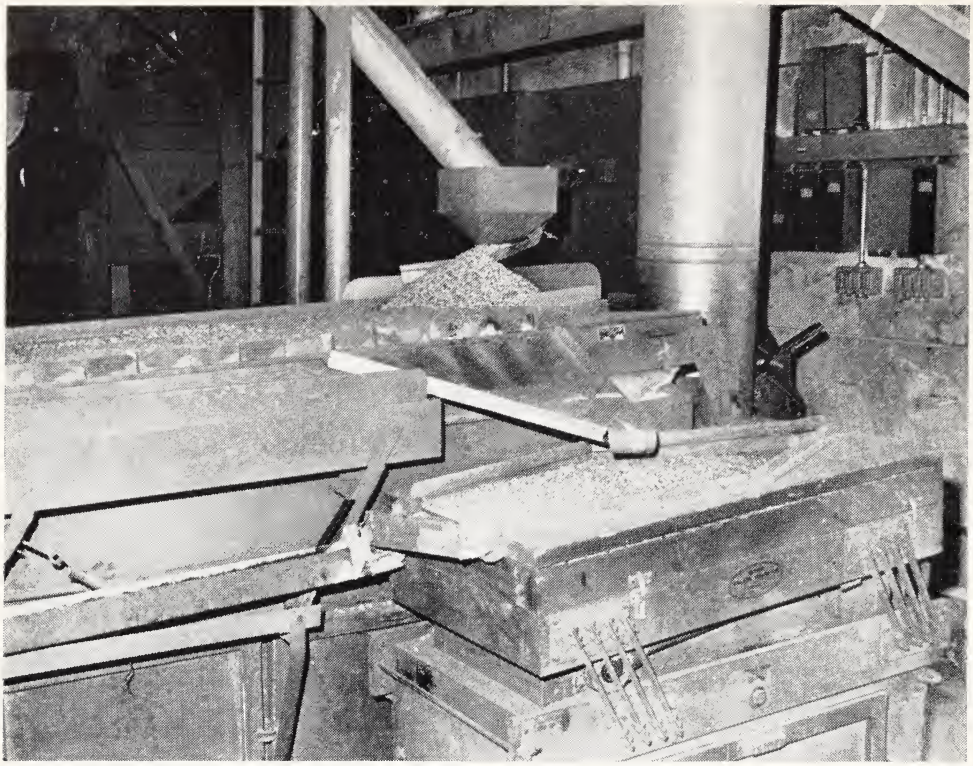
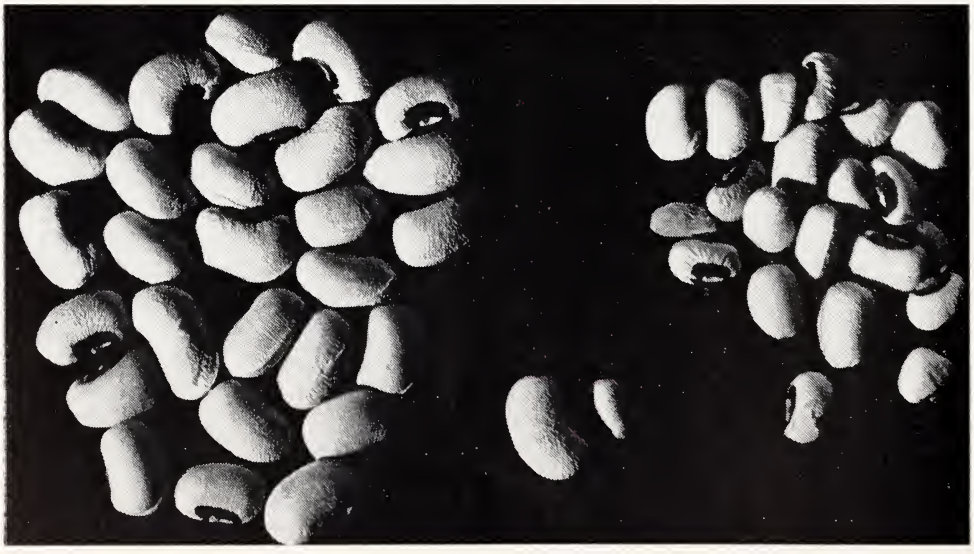


Fig. 10. High-capacity gravity separator that separates light from heavy beans. Also, foreign particles, such as small soil aggregates, are moved to the high side of the separator and off to a small stoner, where beans, soil aggregates, and rocks are again separated. Good beans are then blended back into the elevator.

Fig. 11. Beans on the left show excellent quality. Small, shriveled beans on the right will sell for a lower grade and lower profit.



Marketing

Growers usually process, store, and market their blackeyes through local cooperatives or privately owned warehouses. The warehouse manager or owner acts as a commission merchant for the grower. Blackeyes are sold to dealers by the commission merchant using a sample from the grower's lot of beans to determine U.S. Standard Grade. Then he charges the grower for this service. About six dealers are available in California.

The dealer distributes the beans throughout the nation and to foreign countries through wholesale and retail companies. The beans are usually packaged by companies in the area where they are consumed. Some California dealers package blackeye beans.

Grades for beans are defined in "United States Standards for Beans," available from the United States Department of Agriculture, Production and Marketing Administration. In general, these grades are based on the amount of broken beans, discolored seed, foreign material, weed seed, trash, and the like. Beans below No. 1 grade are either difficult to sell or they sell for a lower price. The packaged product must be attractive to the consumer.

Growers are urged to use good management practices and insect control to produce a No. 1 grade blackeye bean.

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